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ABSTRACT

The University of Southern Queensland (USQ) Distance Education Centre compared the cost and instructional effectiveness of the Optel Telewriter to that of telephone tutorials and face-to-face instruction. Thirty enrollees in a data analysis class used the Optel Telewriter, which permits two-way voice and graphic communication, and 30 other students did not. The Optel Telewriter users passed the course's final examination at a higher rate than did the students in the control group (73% versus 66%) and achieved a higher mean score than the controls (57.46 versus 55.80). Both the students and teachers who used the Optel Telewriter felt that it is a viable alternative to the face-to-face component of distance education. Students indicated that the Optel Telewriter enhanced their academic performance, and teachers stated that it significantly expanded the pedagogical possibilities of the audio teleconferencing system with which they had worked previously. Although tutorials conducted via the Optel Telewriter cost approximately twice as much as telephone tutorials, they were still far more cost-effective than face-to-face instruction. (Appended are a chart detailing the organizational structure of the USQ Distance Education Centre and the student attitude questionnaire. Twelve tables/figures and 13 references are included.) (MN)

AUDIOGRAPHIC COMMUNICATION:
THE OPTEL TELEWRITER TRIAL*

J C TAYLOR, O JEGEDE & R HUNTER
UNIVERSITY OF SOUTHERN QUEENSLAND

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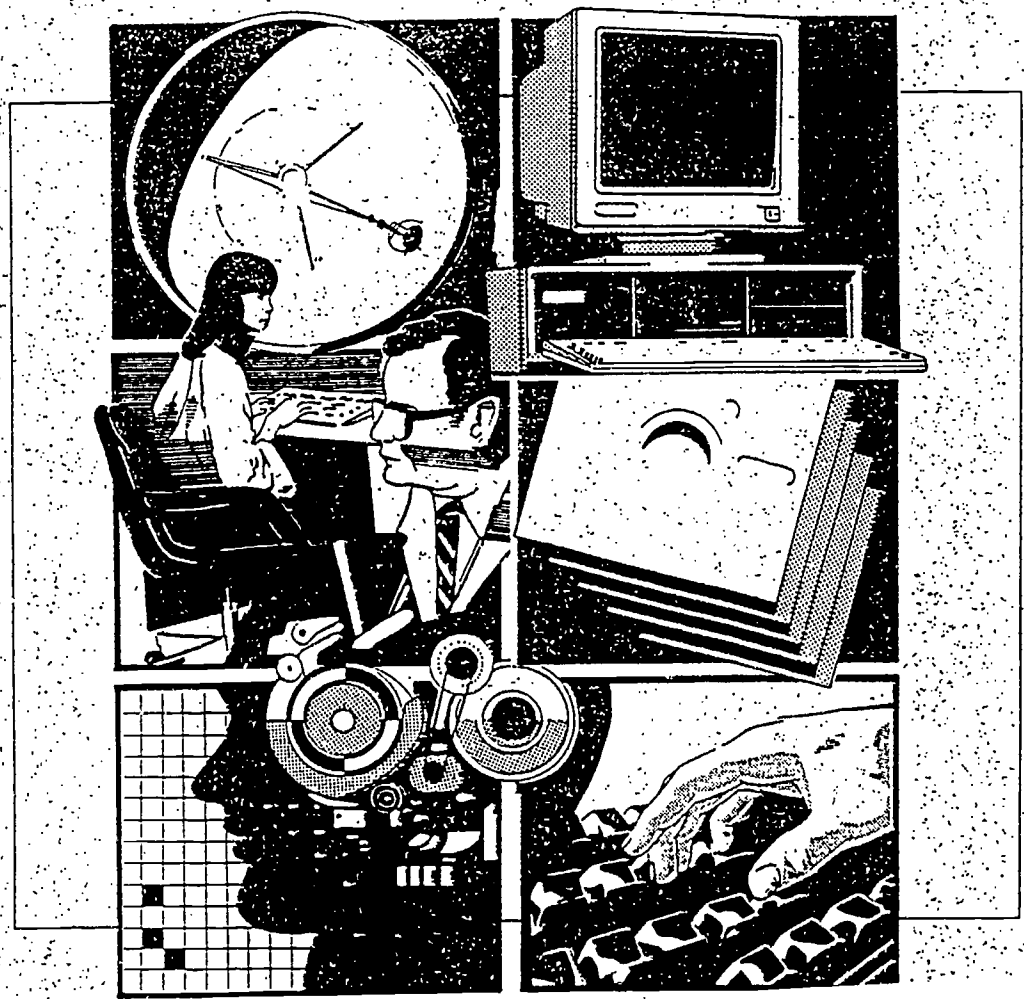

* A report of a project funded under the National Priority (Reserve) Fund of the Department of Employment, Education and Training

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Executive Summary

In recent times, a number of distance education institutions have experimented with ways of using new technologies to supplement, or even replace, the face-to-face component in distance education. One such technology is audiographic communication, which simulates many of the characteristics of face-to-face teaching. Audiographic communication is best conceptualised as an extension of audio teleconferencing, which uses conventional telephone lines to link the teacher and students (in various regional locations) in two-way voice communication for the purpose of what are usually referred to as "telephone tutorials". An audiographic system (eg Optel Telewriter) provides users not only with the capability to interact through two-way voice but also through graphic communication. Two-way graphic communication is achieved through the sharing of visual images simultaneously on two high resolution colour monitors, one for computer graphics and one for video images. Additionally, these screen images can be annotated with the aid of graphics tablets, which in effect can be used as electronic whiteboards.

While the trial was primarily aimed at quality enhancement of a well-established audio teleconferencing system, the objectives of the study encompassed:

(i) a brief review of the theoretical underpinnings of audiographic communication within a broader conceptual framework delineating various models of distance education;

(ii) an evaluation of the academic performance of students exposed to the teaching-learning environment created by the Optel Telewriter;

(iii) an evaluation of the attitudes of both teaching staff and students to the use of the Optel Telewriter; and

(iv) an analysis of the relative costs of audiographic communication, audio teleconferencing and conventional face-to-face teaching.

Overall, the USQ experience with the audiographic communication system suggests that the Optel Telewriter could well provide a viable alternative interactive delivery system for the face-to-face component of distance education. From a pedagogical perspective, it provides

a mechanism for interaction between students and lecturers through spontaneous graphic communication and associated immediate feedback. The quality of such interaction is enhanced by the need for thorough pre-planning, including the preparation of graphic displays (either video or computer based) prior to the teaching session. From a student perspective, involvement in audiographic tutorials was not only regarded as a satisfying learning experience, it also appeared to enhance academic performance. There is, of course, the need for more detailed research on the impact of this technology on student performance relative to different disciplines and various instructional strategies. Initial indications are, however, most promising. Similarly, the teaching staff involved in the trial were all enthusiastic about the system. From their perspective, the Optel Telewriter was extremely user friendly and significantly expanded the pedagogical possibilities of the audio teleconferencing system with which they had worked for a number of years. The lecturing staff involved are all keen to continue to use the audiographic system in future semesters. The extent of such usage will primarily depend upon financial considerations.

While audio teleconferencing is a well established facet of the distance education system at USQ, it is clear that a move to audiographic teleconferencing would virtually double present recurrent costs. While initial indications are that such a change in policy would appear to be warranted on pedagogical grounds, it may not be possible in practice without further additional funding for the University. There is no doubt, however, that the Optel Telewriter deserves serious consideration as an alternative interactive delivery system for distance education. While it is clearly no substitute for those flexible access technologies (print, audiotape, videotape, computer assisted learning), which allow students to work in a place and at a time of their own choosing, its capacity for spontaneous graphic communication and associated immediate feedback makes the Optel Telewriter a pedagogically powerful alternative delivery mode for distance educators, especially in the context of supporting a network of branch campuses, or as a potential alternative approach to residential schools.

AUDIOGRAPHIC COMMUNICATION: THE OPTEL TELEWRITER TRIAL

I Introduction

The essence of distance education as a mode of instruction is that a significant portion of the teaching is conducted by someone removed in space and/or time from the learner. Many distance education systems, however, still entail a degree of face-to-face teaching either through students attending residential schools on the main campus of an institution, or through students visiting study centres for interaction with regional tutors. In recent times, a number of distance education institutions have experimented with ways of using new technologies to supplement, or even replace, the face-to-face component in distance education. One such technology is audiographic communication, which simulates many of the characteristics of face-to-face teaching.

Audiographic communication is best conceptualised as an extension of audio teleconferencing, which uses conventional telephone lines to link the teacher and students (in various regional locations) in two-way voice communication for the purpose of what are usually referred to as "telephone tutorials". An audiographic system provides users not only with the capability to interact through two-way voice but also through graphic communication. Two-way graphic communication is achieved through the sharing of visual images simultaneously on two high resolution colour monitors, one for computer graphics and one for video images. Additionally, these screen images can be annotated with the aid of graphics tablets, which in effect can be used as electronic whiteboards (Figure 1).

The audiographic system illustrated, the Optel Telewriter[1], enables the teacher to communicate spontaneously with students in different locations. Both the teacher and the groups of students see instantaneously the graphic presentations on screen and can readily interact through the audio teleconference medium. This scenario is therefore analogous to face-to-face teaching in which chalkboard presentations, visual aids, interactivity and

1 Registered trademark of Optel Communications. Inc.

immediate feedback are all salient features, thus making audiographic communication an apparently attractive alternative delivery system for distance education.

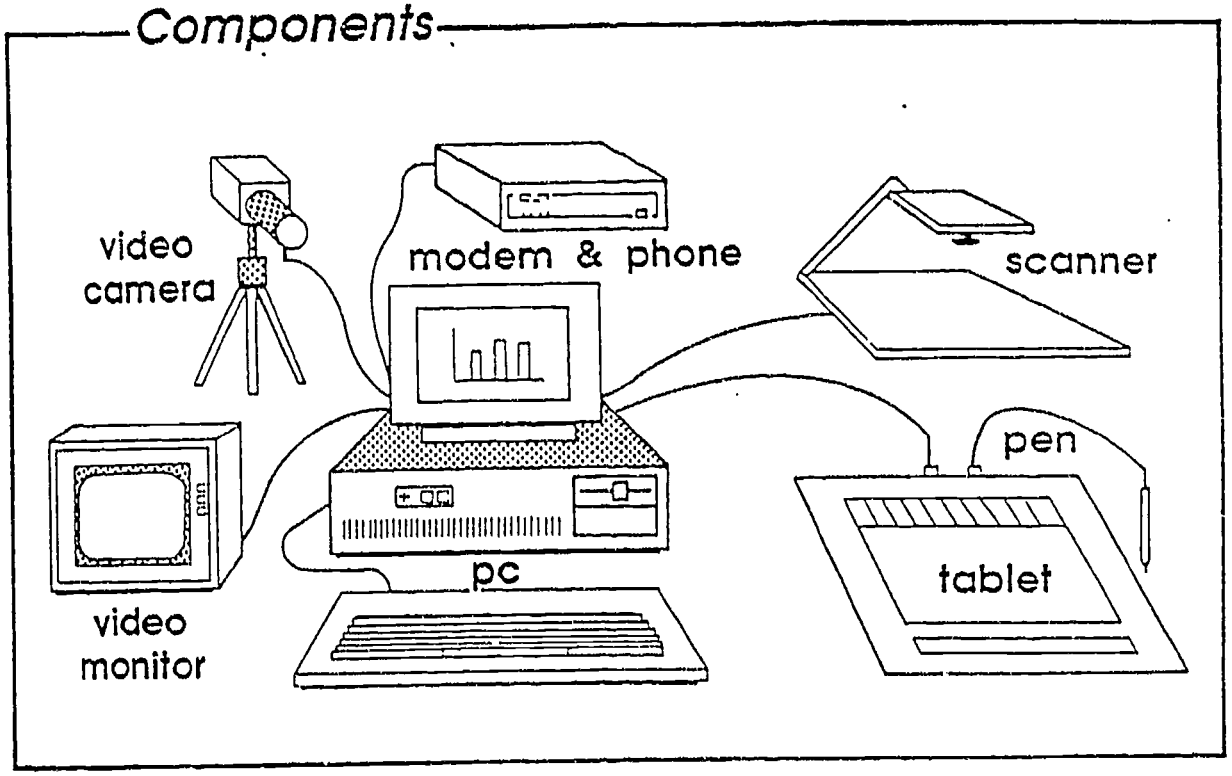


Figure 1: Overview of audiographic communication system

The University of Southern Queensland (USQ), formerly the University College of Southern Queensland, was awarded a grant of $190,000 by the Department of Employment, Education and Training to evaluate the potential of the Optel Telewriter to enhance the quality of teaching and learning in the context of a well-established distance education system. USQ, as a recognised Australian Distance Education Centre, provides distance learning to over 7,000 students, including approximately 800 overseas students resident primarily in Hong Kong, Malaysia and Singapore (Figure 2).

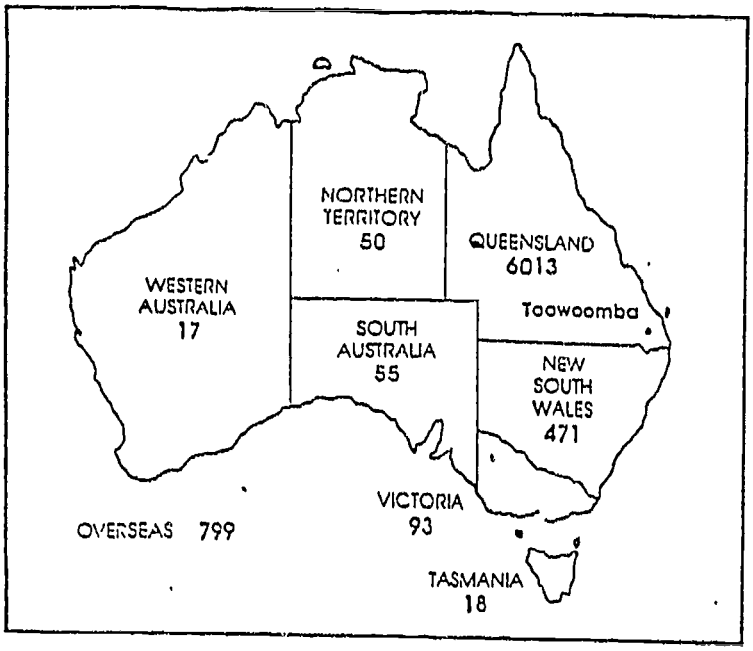


Figure 2: External student distribution, Semester 1, 1991

USQ has been a major provider of distance education courses since 1977, and has made extensive use of teleconferencing to its 20 regional study centres and a number of overseas locations in the past 12 years. Many teaching staff of USQ have therefore had considerable experience in the provision of telephone tutorials; for example, 261 such teleconferences were run in 1991. The enhancement of this telephone tutorial system with the purchase of five Optel Telewriter workstations provided an appropriate context in which to undertake a comprehensive evaluation of audiographic communication as an alternative delivery system for distance education.

While the trial was primarily aimed at quality enhancement of a well-established audio teleconferencing system, the objectives of the study encompassed:

(i) a brief review of the theoretical underpinnings of audiographic communication within a broader conceptual framework delineating various models of distance education;

(ii) an evaluation of the academic performance of students exposed to the teaching-learning environment created by the Optel Telewriter;

(iii) an evaluation of the attitudes of both teaching staff and students to the use of the Optel Telewriter; and

(iv) an analysis of the relative costs of audiographic communication, audio teleconferencing, and conventional face-to-face teaching.

The evaluation therefore focussed on the attitudes of both staff and students towards audiographic communication, the academic performance of students, and considerations of cost-effectiveness. This report summarises the USQ experience with the Optel Telewriter, delineates the advantages and limitations of this new technology, and briefly examines the implications for contemporary and future directions in the use of this type of technology as a supplement for, or replacement of, the face-to-face component in distance education systems.

II Theoretical Context

Most Australian institutions involved in distance education do not opt for a single approach, but deploy a wide range of delivery technologies, including various combinations of printed study guides, audiotapes, videotapes, audio teleconferencing, computer conferencing, computer-based learning and audiographic communication. In a paper prepared originally for the Working Party of the National Distance Education Conference (NDEC) on Education and Technology, Taylor (1991) proposed a conceptual framework for comparing various characteristics of delivery technologies in the context of three successive generations of distance education, represented by the Correspondence Model, the Multi-media Model and the Telelearning Model respectively (Table 1).

Table 1: Distance education and technology: a conceptual framework

Models of Distance Education and Associated Delivery Technologies	Characteristics of Delivery Technologies						
	Flexible Access		Resource Based	Highly Refined Materials	Advanced Interactive Delivery	Pedagogically Effective*	Cost Effective*
	Independent of Time	& Place					
Correspondence Model							
• Print	Yes	Yes	Yes	Yes	No	?	?
Multi-media Model							
• Print	Yes	Yes	Yes	Yes	No	?	?
• Audiotape	Yes	Yes	Yes	Yes	No	?	?
• Videotape	Yes	Yes	Yes	Yes	No	?	?
• Computer-based learning (e.g. CML/CAL)	Yes	Yes	Yes	Yes	Yes	?	?
• Computer conferencing (EMail etc.)	Yes	Yes	Yes	No	Yes	?	?
• Telephone	Yes	Yes	Yes	No	Yes	?	?
• Interactive video (disk and tape)	Yes	Yes	Yes	Yes	Yes	?	?
• CDTV	Yes	Yes	Yes	Yes	Yes	?	?
Telelearning Model							
• Audioteleconferencing	No	No	No	No	Yes	?	?
• Audiographic communication (e.g. Optel Telewriter)	No	No	Yes	Yes	Yes	?	?
• Broadcast TV/Radio + audio teleconferencing	No	No	Yes	Yes	Yes	?	?
• Videoconferencing	No	No	No	No	Yes	?	?

* *Research and evaluation required on specific courses in particular contexts.*

The delivery technologies, such as the Optel Telewriter, which constitute the Telelearning Model are characterised primarily by "advanced interactive delivery" based on contiguous two-way communication between students and teachers, thereby simulating conventional face-to-face teaching. These technologies are most clearly differentiated from the other distance education delivery technologies by the fact that students must be present in a particular place (e.g. branch campus, TV studio, regional study centre etc.) at a specific time in order to participate in the educational process. Unlike the technologies that constitute the Multi-media model, the telelearning delivery technologies do not enable students to work in a place and at a time of their own choosing. Despite the fact that telelearning technologies such as the Optel Telewriter are not characterised by providing "flexible access" for students, the potential pedagogical efficacy of contiguous two-way communication between teachers and students, the growing trend for universities to establish a network of branch campuses and to seek alternative approaches to the residential school components of distance education courses suggest that the Optel Telewriter is worthy of investigation. Indeed, within the context of the Telelearning Model of distance education, it could well be the most effective delivery technology.

While there is clearly a need for more research and evaluation of the use of telelearning technologies for particular distance education courses, from a theoretical perspective audiographic communication would appear to have certain pedagogical advantages over audio teleconferencing, videoconferencing and broadcast TV/radio used in conjunction with audio teleconferencing. For example, the Optel Telewriter because of its capacity for two-way graphic communication (video images, computer graphics and electronic whiteboard) is clearly superior to audio teleconferencing alone. Similarly, broadcast TV/radio used in conjunction with audio teleconferencing lacks the potential pedagogical power of two-way graphic communication. Further, videoconferencing, despite its capacity to exploit the presentational qualities of the video medium, is essentially based on putting teachers in front of the technology in a manner which simulates conventional face-to-face teaching, thereby often promoting "talking head" lectures at the expense of providing more effective teaching-learning experiences based on active participation. It is, of course, almost impossible to generalise about the pedagogical efficacy of delivery technologies, because it is the structure and quality of the specific instructional message, not so much the inherent

characteristics of a particular delivery technology (medium) that is of critical importance (Taylor, 1987; Bates, 1991). This critical issue was also highlighted by Clark (1983) when he pointed out that media are "mere vehicles that deliver instruction but do not influence student achievement any more than the truck that delivers our groceries causes changes in our nutrition" (p.445). In short, although there are differences in the instructional potential of various delivery modes, pedagogical efficacy is more a function of instructional design technology by which the educational message is created than of the instructional medium through which the educational message is delivered.

The creation of the educational message for audio teleconferencing and videoconferencing does not necessarily demand detailed pre-planning and associated preparation of teaching-learning resources since both of these technologies facilitate traditional delivery rather than resource design and therefore are not dependent on the use of "highly refined materials" (Table 1). In contrast, both broadcast TV/radio and audiographic communication, especially the latter, demand detailed planning. In the case of the Optel Telewriter, the systematic preparation of a range of visual presentations (computer graphics, video images etc.) and associated interactive learning activities, based on the use of the electronic tablet, creates an effective interactive learning environment. It could well be that the Optel Telewriter's inherent combination of highly refined teaching-learning resources and capacity for advanced interactive delivery generates an efficacious teaching-learning environment.

III Practical Context

The number of Optel workstations was limited to five with the Toowoomba USQ campus acting as the originating centre. Selection of the other four participating centres was made on the grounds of student population, centre facilities and security, and regional liaison officer participation. Distance was not identified as a critical selection criteria and, hence, all four centres were within one day's travel of Toowoomba. The centres were - Toowoomba, Dalby, Warwick, Brisbane and Hervey Bay (Figure 3).

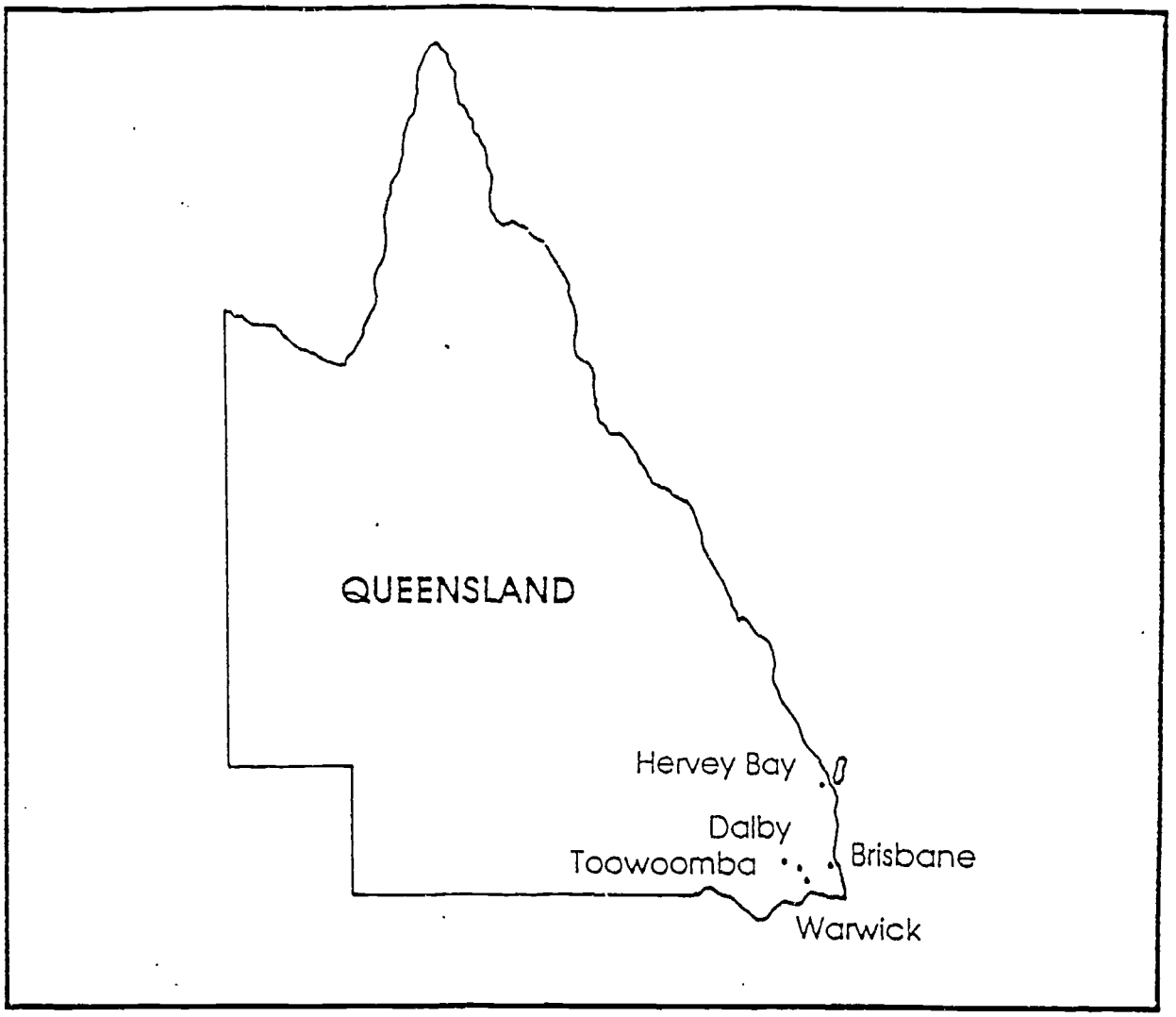
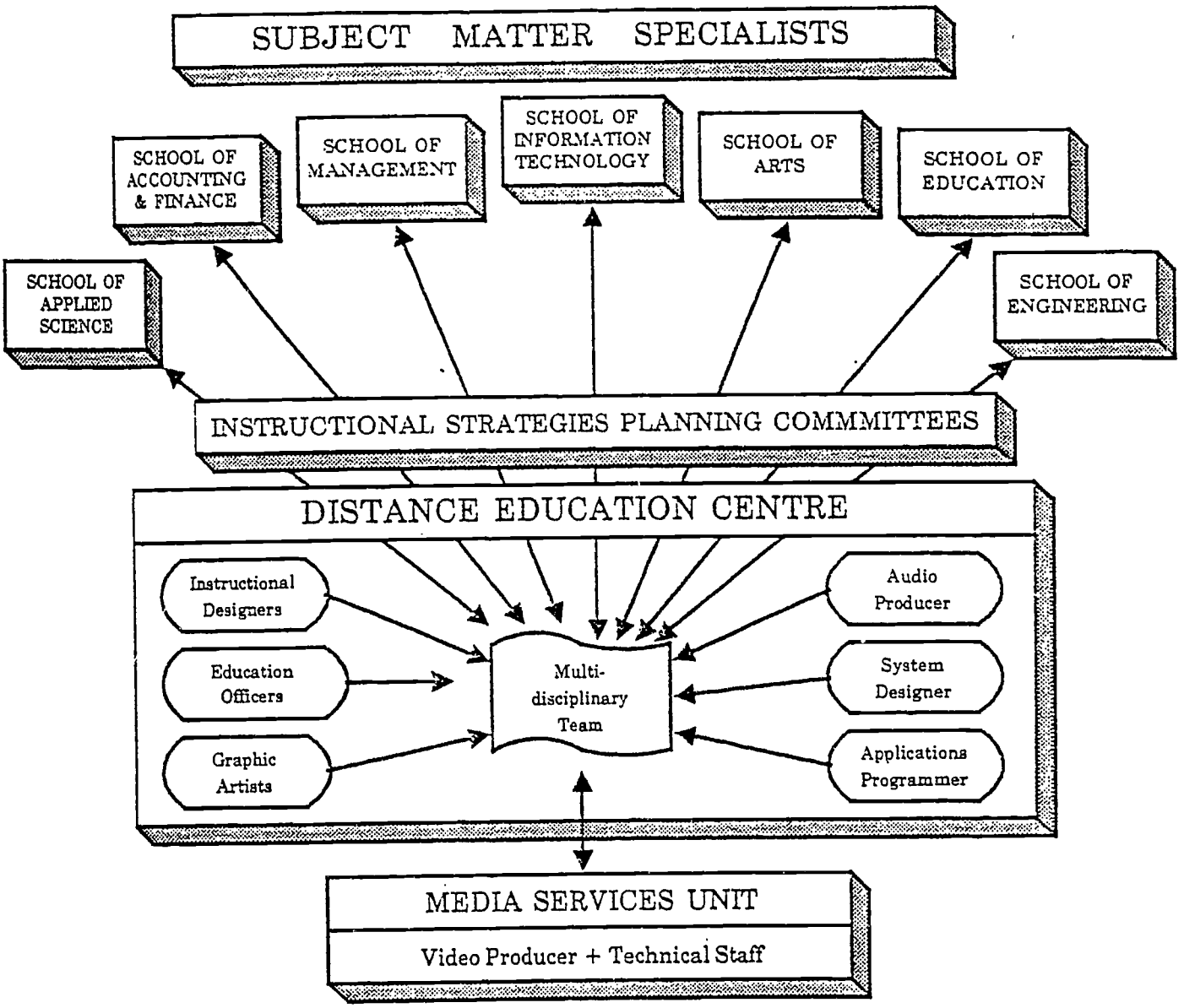


Figure 3: Location of Optel Telewriter centres

The Management of the hardware and software was the responsibility of the Instructional Technology section of the DEC (Appendix A). After the initial training of five days duration provided by Olivetti, the suppliers of the Optel equipment in Australia, the computer systems officers involved had no difficulty in using the system which operated in the context (Figure 4) of the USQ DEC multi-disciplinary approach to teaching (Taylor, 1991).



Responsibilities of Unit Team Members

Phase	Team Members	Responsibilities
Design	Instructional Designer + Subject Matter Expert(s) + Education Officer	1. Generate a detailed instructional development blueprint. 2. Prepare a timeline for the project.
Development	Instructional Designer	1. Train the subject matter expert(s) to use the blueprint for development. 2. Coordinate the production of learning materials.
	Education Officer	1. Provide administrative support to the unit team. 2. Implement procedures associated with maintenance of data bases (unit specification, assignment, CML, mailing), residential school, telephone tutorials, copyright, etc.
	Subject Matter Expert(s)	1. Produce learning materials, (written instruction, self-assessment questions, scripts, CML, etc.) according to the instructional blueprint.
	Media Specialist(s) • audio-visual • computing • graphics	1. Produce learning materials according to prescribed medium and design.
Evaluation	Total Development Team	1. Review and revise learning materials.

Figure 4: Overview of organisational structure for the preparation of instructional materials (USQ).

At the USQ, the Dean of the relevant teaching school is ultimately responsible for the academic content of the unit, while the Head of the Distance Education Centre is responsible for the instructional quality of the learning materials. The Dean of the teaching school appoints one or more subject specialists to the team, while the Head of the Distance Education Centre appoints an instructional designer, education officer, plus specialists in audio, video, graphics and computer-based education as required . Planning for the use of the Optel Telewriter was therefore conducted in the context of a well-established multi-disciplinary support infrastructure.

Because of the lack of experience with, and unknown reliability of, the Optel equipment the trial was limited to the conduct of audiographic tutorials in the following three units of study:

75001:	Introduction to Computing
75002:	Data Analysis
AE101:	Preparatory Mathematics

Consistent with the well-established telephone tutorial system, sessions were limited to a maximum of two per unit to supplement the distance education packages, consisting of printed study guides, books of readings and computer-managed learning packages. This decision to limit the number of sessions per unit was also influenced by the concern that the preparation time was difficult to predict for both the lecturers involved and the associated computer systems officers. While this strategy may appear to have been somewhat conservative, a more extensive trial that may have led to numerous unforeseen difficulties could have been disastrous for the future long term development of the system. In any event, the scope of the trial was sufficient to address the major objectives of the evaluation, focussing on student academic performance, student attitude, staff attitude and cost effectiveness respectively.

IV Students' Academic Performance

According to Johnstone and Gilcher (1988), one of the three major areas of concern that affect the success or otherwise of an audiographic network is students' use of and satisfaction with the system. Because of relatively limited attendance at the other sessions, indications of student academic performance as a result of using the Optel system concentrated on those enrolled in the Data Analysis unit. A total of 61 students were used for the experimental trial sessions at the USQ Brisbane Centre. Half of them availed themselves of the opportunity of audiographic communications through three Optel study sub-groups under the leadership of three students selected by the sub-groups. It should be noted that this group of students consisted of those who at the beginning of the semester "advised that they were experiencing difficulty with understanding the concepts taught" in the Data Analysis unit. The other half of the group (n = 30) served as the control.

Using the end of semester final examination of the course as the basis of comparison the group which used the Optel Telewriter in their study sessions obtained a relatively better result (Table 2).

Table 2: Frequency distribution of Data Analysis final examination scores of students participating in the Optel Trial

Grades	All(N=60)	Group with Optel (N=30)	Group without Optel (N=30)
HD	03 (05.0%)	01 (03.3%)	02 (06.7%)
A	06 (10.0%)	04 (13.3%)	02 (06.7%)
B	12 (20.0%)	05 (16.7%)	07 (23.3%)
C	21 (35.0%)	12 (40.0%)	09 (30.0%)
F	16 (26.7%)	06 (20.0)%	10 (33.3%)
IS	02 (03.3%)	02 (06.7%)	0
Mean Score	56.63	57.46	55.80
Standard Deviation	18.89	17.41	20.53

HD = High distinction, F = Fail, IS = Incomplete (Supplementary assessment required)

The spread of the scores for the group with Optel displayed a distribution pattern wherein there were more passes within the A grade than the group without the Optel. A higher failure rate of 33.3% was recorded for the group without the Optel. While about 73% of the students who studied via the Optel passed the final examination (and this does not include the 6.7% with supplementary examinations to take), only 66% of the group without the Optel facilities passed. Table 2 also indicates that the group with Optel had a higher mean score ($\bar{X} = 57.46$, S.D = 17.41) than the group without Optel ($\bar{X} = 55.80$, S.D = 20.53). It is observed that the mean score for the latter group is lower than the combined group mean of 56.63. Considering the number of students in the trial, the limited number of Optel sessions and other factors which may have intervened in the study, the mean score difference (1.66) between the groups (in favour of the group which used the Optel) indicated a very positive trend. These results are even more encouraging, if we consider the fact that the three Optel study groups consisted of students who advised that they were experiencing difficulty with the subject, whereas the control group was chosen at random. The "at risk" group could also be regarded as having sufficient motivation to overcome their fear of failure, evidenced by their preparedness to make the additional effort to attend the study centre to participate in the Optel sessions.

V Student Attitude

The responses of the students to the attitude questionnaire designed to investigate their perceptions of both technical and instructional quality (Appendix B) in relation to items which probed their evaluation of the impact of the new technology seem to confirm the role Optel plays in enhancing achievement in the Data Analysis unit. For instance, as shown in Table 3, 94% of the students asserted that the Optel sessions significantly contributed to their learning (see item 6) while 87% expressed the view that after participating in the Optel sessions, they gained information or learnt to do things they could not do before.

Table 3: Students responses to the attitude questionnaire on the Optel Telewriter trial

Items	Excellent	Satisfactory	Unsatisfactory
1 Quality of the reception during the sessions	10 (32%)	21 (68%)	0 (00%)
2 Clarity of audio	15 (48%)	15 (48%)	1 (03%)
3 Were the examples helpful?	13 (42%)	16 (52%)	2 (06%)
4 Appealing nature of the graphics	27 (87%)	04 (13%)	0 (00%)
5 Presenter was well prepared	19 61%)	12 (39%)	0 (00%)
6 The session significantly contributed to my learning	13 (42%)	16 (52%)	2 (06%)
7 How successful is the use of the Optel Telewriter?	18 (58%)	11 (36%)	2 (06%)
8 Interactive discussions during the sessions	17 (55%)	09 (29%)	5 (16%)
		YES	NO
9 Were the sessions interesting?		31 (100%)	0 (00%)
10 After participating in the session, did you gain information or learn to do things you could not do before?		27 (87%)	4 (13%)
11 Would you like to see the use of the system increased?		31 (100%)	0 (00%)

As indicated in the data presented in Table 3, all the students (100%) believed the technical presentation (i.e. clarity of reception of visual material and of audio component) was excellent or satisfactory. Similarly, the majority of students believed the sessions to be interesting, informative, appealing and helpful. With regard to interactivity, 16% of the students found the interactive discussions during the sessions unsatisfactory. This response no doubt reflected the fact that to have 31 people participating in a tutorial, whether face-to-face or via the Optel system, is less than satisfactory, since interactivity is likely to be curtailed by such a relatively large number of participants. However, such an issue did not detract significantly from the perceived value of the system, since without exception all students believed that there should be an increase in the use of the Optel Telewriter system for instructional purposes.

Finally, with responses to the structured items on the questionnaire, students thought the presenter was well prepared, had a good grasp of the content and delivered the tutorials very well through the Optel system. Most students indicated that the sessions had significant impact on their learning. Further, the apparent student acceptance of the Optel system was reflected in typical responses to the "open ended" questions included in the questionnaire, as follows:

How does this delivery system affect the quality of your performance as a student?

* Interaction very helpful.
* Helpful to see actual formulae rather than hope that you heard them right during the teletute.
* Far more benefit (understanding wise) than teletute.
* More immediate feedback very beneficial.

What do you like about the technology/delivery system?

* It's fun, interaction, visual contact.
* Better for understanding what is being talked about.
* Better for the applied, practical aspects of subjects.

What do you dislike about the technology/delivery system?

* Unable to get a print copy of the screens.
* The visual overpowers the interactive capability.
* Slow at times.

Is there anything you would want to change about the way you are using this technology?

* Larger screen or smaller group.
* This technology should encourage even more interaction.
* Add a printer to dump screens.
* Touch sensitive screen instead of port.

The summary of students' personal reactions to questions seeking open-ended views as detailed above seem to have some implications for a number of issues related to the Optel Telewriter system as an instructional delivery medium within the context of the Data Analysis unit. First the efficacy of the audiographic communication technology for instruction with particular reference to interaction, viewing and use for applied, practical activities is supported. Second, the need to use it for smaller groups and its probable advantage over teletutorials is stressed. Third, as a piece of technological hardware Optel's further development might need to consider the refinement/addition of a larger screen, increased speed of processing or transmission, the ability to print to an output device and the inclusion of a touch sensitive screen.

When considered in the overall context of responses collected from the 130 students, who participated in the Optel based teletutorials (Table 4), it seems reasonable to conclude that a sufficient number of students was favourably disposed to the technical, presentational and instructional qualities of the medium to warrant its continued use.

Table 4: Student reactions to the Optel Telewriter trial

Evaluation Criteria	More than Satisfactory	Satisfactory	Less than Satistactory
Quality of Tutorials			
Technical	34%	49%	17%
Presentation	55%	39%	6%
Acceptance of Medium	50%	41%	9%
Instructional Qualities			
Effectiveness	38%	49%	13%
Interactivity	45%	39%	6%

At the same time, it is clear that more extensive trials of the system will be required before definitive statements can be made on the instructional efficacy of the Optel Telewriter across a range of both subject matters and student target audiences.

VI Staff Attitude

The teaching staff, instructional designers, computer systems officers and study centre coordinators, who were users of the system in various ways, all reacted positively to the Optel system. First, the teaching staff generally expressed the view that the Telewriter was easy to learn how to use. Although the need for detailed pre-planning made additional demands on their time, such efforts were regarded as worthwhile because of the expanded possibilities for meaningful interaction provided by the graphic capabilities of the system. It is worth noting that the three staff members involved had a substantial degree of prior experience in audio teleconferencing, which no doubt helped them to make effective use of the system. This positive attitude was probably reinforced by the fact that there were no major technical problems in any of the sessions.

To some degree each of the three lecturers reported that the experience was too limited to adequately assess the impact of the technology on their style of teaching. While all agreed that the content focus of each tutorial was unaltered, there was a consensus that the availability of an audiographic system led to their emphasising the interactive aspects of teaching, particularly student activities in their planning of the sessions. Indeed, one of the staff members regarded such interaction as so prominent a force that he felt that the

students became the controlling influence during the course of the tutorial. This led to the suggestion that to make optimal use of the system it would be necessary to train students as well as lecturers on how to make the best use of the technology. Overall, though, all lecturers involved in the trial expressed their enthusiasm for the audiographic approach and their desire to continue their work with the Optel system.

Similarly, the instructional designers and computer systems officers were pleased with the experience of their respective roles in the trial. Both groups were excited by the pedagogical opportunities offered by the system, especially as the user-friendliness of the Optel system meant that it was easy to learn to operate. This view was confirmed by the study centre coordinators, who were trained by the computer systems staff, when the equipment was set up in the remote sites. Additional further training was conducted using the Optel system itself, without any difficulties arising. Further, the study centre staff were able to confirm the view that students reacted very positively to the opportunity to work with the Optel system. In particular, the Brisbane Centre coordinator detected an apparent positive attitude switch in those "at risk" students in the Data Analysis unit, who provided the focus for the major trial of the system.

As a whole, attitudes towards the use of the Optel Telewriter were universally positive. The staff, like the students, not only found the technology acceptable, but were positively enthusiastic about the possibilities of the system. Similarly, throughout the year, demonstrations of the system (a total of 68) to a wide range of visitors to the DEC, who include professionals in such diverse fields as medicine, language teaching, engineering, accounting and economics, have reacted with intense interest in the pedagogical possibilities of the system, especially in the context of continuing professional education undertaken via the distance education mode. The extent to which this potential will be realised, is of course, dependent on numerous variables, not the least of which is considerations of cost and associated economic viability.

VII Cost Effectiveness

Costs for the trial fell into three categories: capital costs and infrastructure establishment, preparation costs, and delivery costs. The capital costs comprised the equipment and furniture expenses. Establishing the infrastructure followed negotiations with each regional centre involved Telecom lines, equipment delivery and staff training. All of these costs totalled $153,917 as detailed below (Table 5).

Table 5: Capital and infrastructure costs

	Item	Cost ($)	Total Cost ($)
Main Campus	• Optel workstation	25,640	
	Microcomputer	4,835	
	Laser Printer	5,499	
	Image software	1,824	
	Scanner, video camera	3,270	
	• Furniture	538	
	Security	200	
	Telecom Service	250	42,056
Regional Centre	• Optel workstation	25,640	
	Furniture	538	
	Security	200	
	Telecom service	250	
	• 4 x centres	26,628	106,512
Delivery	• Delivery to 4 centres	2,718	
Training	• Staff training	2,631	5,349
Total Costs			$153,917

Preparation costs involved work by the lecturer, an instructional designer and the computer programmers, plus administrative costs. These varied markedly during the trial as each lecturer worked in a different fashion. What did emerge during these development periods is that the times spent by the lecturer and the programmer were approximately equal. Cost estimates for preparation are $2,275 for a total of 410 minutes of instruction. Hence, the average preparation costs for a 60-minute tutorial was $333. However, this figure falls within the range of $194 - $424.

Delivery costs comprised Telecom charges and workloads of the presenter, CBT programmer and centre supervisors. Apart from Telecom charges which vary depending upon centre location, the other costs have minimal variation for a 60-minute tutorial. These support costs amounted to $162 for a two-centre hook-up (Toowoomba plus one more). The Telecom charges for a two-centre hook-up range from $65 to $132. Thus, the cost of delivery of a 60-minute tutorial involving two centres ranged from $227 to $294.

Projected costs for a 60-minute tutorial to differing numbers of centres are presented in Table 6.

Table 6: Cost of 60-minute Optel Telewriter tutorial

Cost/Item	Number of Centres Connected			
	2	5	10	15
Preparation ($)	333	333	333	333
Delivery ($)				
Telecom (Min/Max)	65/132	206/317	419/707	629/1097
Support	162	252	402	552
Total ($) (Min/Max)	560/627	791/902	1154/1442	1514/1982

It is interesting to compare the cost of preparation and delivery of an audiographic tutorial with an audio tutorial. For comparison some assumptions are made - preparation by the lecturer totals one half-day, supervision is required at the originating centre and each of the receiving centres. The estimate costs of a 60-minute audio tutorial are shown below (Table 7).

Table 7: Cost of 60 minute audio tutorial

Cost/Item	Number of Centres Connected			
	2	5	10	15
Preparation ($)	109	109	109	109
Delivery				
Telecom (Min/Max)	32/66	95/183	200/378	305/573
Support	132	222	272	322
Total ($) (Min/Max)	273/307	426/514	581/7592	736/1004

Final costs per student obviously depend upon the total number of students in attendance. Optimum attendance for an audiographic communication tutorial using Optel Telewriter is 4-5 per workstation. Attendance at an audio-only telephone tutorial is not so restricted. However, for USQ, telephone tutorials conducted during Semester 1 of 1991 resulted in 4,055 students attended a total of 929 hook-ups; an average of 4-5 per centre. Comparison costs assuming 5 students per centre, are shown below (Table 8).

Table 8: Comparison of costs of audiographic and audio tutorials

Cost/Item	Number of Centres Connected			
	2	5	10	15
Number of students	5	20	45	70
Cost ($) (Min/Max)				
Audio only	273/307	426/514	581/759	736/1004
Audiographic	560/627	791/902	1154/1442	1514/1982
Cost per student ($) (Min/Max)	132	222	272	322
Audio only	55/61	21/26	13/17	11/14
Audiographic	112/125	40/45	26/32	22/28

These figures illustrate that the cost of an audiographic tutorial is approximately twice that of a telephone tutorial. It should be noted that if there was one student at each of 14 receiving centres the cost per student is comparable with having five students at a single centre (i.e. about $108/142 per student), depending on the location of the centre(s).

In the current trial, linking five centres with an average total attendance of 26 students, the cost per student was $48. An equivalent scenario using audio teleconferencing only would be approximately 50% cheaper, but would of course lack the pedagogical impact of the visual interactivity. When compared with alternatives for creating actual face-to-face contact between lecturers and students by having teaching staff travel around regional centres or by having students travel to the main campus, both the audiographic communication system and conventional audio teleconferencing are extremely attractive from a cost-effectiveness perspective. The ultimate cost-effectiveness of the use of such technologies in particular contexts is, of course, a more complex question, depending on existing infrastructures, technical support requirements, and degree of usage relative to the initial capital investment and life of the system. This issue is the subject of an ongoing more extensive evaluation project, which will include a direct comparison with videoconferencing.

VIII Conclusion

Overall, the USQ experience with the audiographic communication system suggests that the Optel Telewriter could well provide a viable alternative interactive delivery system for the face-to-face component of distance education. From a pedagogical perspective, it provides a mechanism for interaction between students and lecturers through spontaneous graphic communication and associated immediate feedback. The quality of such interaction is enhanced by the need for thorough pre-planning, including the preparation of graphic displays (either video or computer-based) prior to the teaching session. From a student perspective, involvement in audiographic tutorials was not only regarded as a satisfying learning experience; it also appeared to enhance academic performance. There is, of course, the need for more detailed research on the impact of this technology on student performance relative to different disciplines and various instructional strategies. Initial indications are, however, most promising. Similarly the teaching staff involved in the trial were all enthusiastic about the system. From their perspective, the Optel Telewriter was extremely user friendly and significantly expanded the pedagogical possibilities of the audio teleconferencing system with which they had worked for a number of years. The lecturing staff involved are all keen to continue to use the audiographic system in future semesters. The extent of such usage will primarily depend upon financial considerations.

While audio teleconferencing is a well established facet of the distance education system at USQ, it is clear that a move to audiographic teleconferencing would virtually double present recurrent costs. While initial indications are that such a change in policy would appear to be warranted on pedagogical grounds, it may not be possible in practice without further additional funding for the University. There is no doubt, however, that the Optel Telewriter deserves serious consideration as an alternative interactive delivery system for distance education. While it is clearly no substitute for those flexible access technologies (print, audiotape, videotape, computer-assisted learning), which allow students to work in a place and at a time of their own choosing, its capacity for spontaneous graphic communication and associated immediate feedback makes the Optel Telewriter a pedagogically powerful alternative delivery mode for distance educators, especially in the context of supporting a network of branch campuses, or as a potential alternative aproach to residential schools in certain disciplines.

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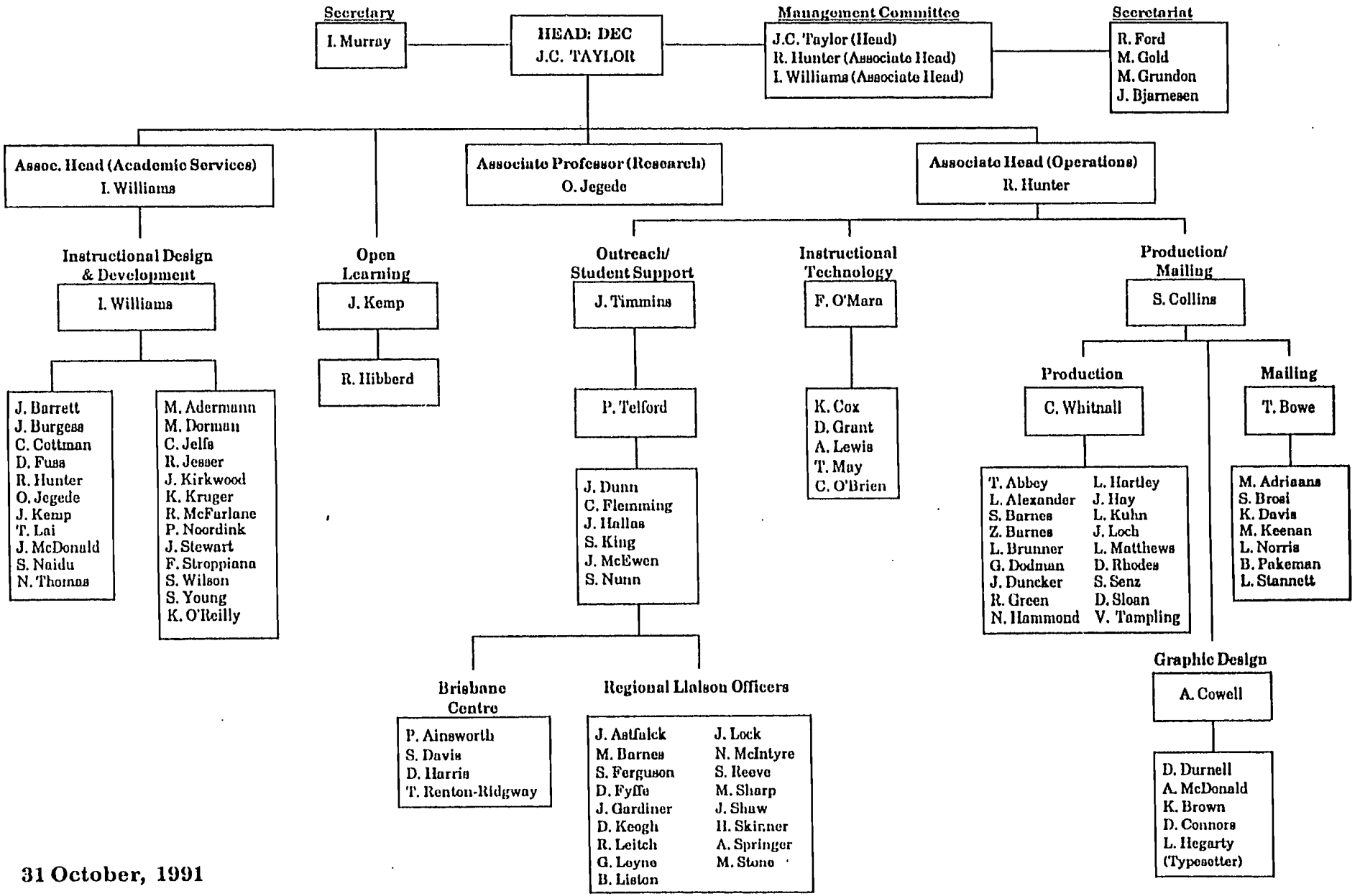
APPENDICES

Appendix A

DISTANCE EDUCATION CENTRE – UNIVERSITY COLLEGE OF SOUTHERN QUEENSLAND



31 October, 1991

Appendix B

Optel Telewriter Trial Evaluation. (Student)

Thank you for helping to conduct this evaluation. We would like to know something about your appraisal to the use of the Optel Telewriter.

Would you please answer the following questions.

Name. (optional) _____ Unit No. _____ Date _____

Session Duration (minutes) _____

Total no. of participants attending the session with you _____

The quality of the reception during the session was generally:

Why _____

- Excellent ☐
- Satisfactory ☐
- Unsatisfactory ☐

During the session the audio was clear:

Why _____

- Excellent ☐
- Satisfactory ☐
- Unsatisfactory ☐

I felt that the use of the Optel telewriter was:

Why _____

- Very successful ☐
- Moderately successful ☐
- Moderately unsuccessful ☐
- Very unsuccessful ☐

How does this delivery system effect the quality of your performance as a student?

_____

_____

_____

What do you like about the technology delivery system?

_____

_____

_____

What do you dislike about the technology delivery system?

_____

_____

_____

Is there anything you would want to change about the way you were using this technology?

_____

_____

_____

Was the session interesting? Yes ☐ No ☐

Were the examples helpful?

Excellent ☐
Satisfactory ☐
Why _____ Unsatisfactory ☐

After participating in the session did you gain information or learn to do things you could not do before? Yes ☐ No ☐

Was the use of graphics appealing ☐ or distracting ☐

Would you like to see the use of the system increased Yes ☐ No ☐

I was satisfied with the interactive discussions I had during the session

Very satisfied ☐
Moderately satisfied ☐
Moderately unsatisfied ☐
Why _____ Very unsatisfied ☐

The presenter was well prepared for the session

Excellent ☐
Satisfactory ☐
Why _____ Unsatisfactory ☐

The optel telewriter session contributed significantly to my learning

Excellent ☐
Satisfactory ☐
Why _____ Unsatisfactory ☐

Please add any further advice or comments that you would wish to make.

_____

_____

_____

Thank you